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NEURONAL ADAPTIVE MECHANISMS UNDERLYING INTELLIGENT INFORMATION PROCESSING

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Advances made in our research during the past year include (1) determination of effects of clycic AMP, a neuromodulatory chemical, on neurons of the motor cortex and (2) documentation, by computer analysis, of a 100-fold increase in the rate or acquisition of conditioned learning by adding stimulation of the hypothalamus to the usual associative presentatins of CS and US.

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ABSTRACT

The human brain is the most powerful adaptive network known to man. It is responsible for human intelligence with operations involving automated image recognition, speech, decision making and complex motor functions. The same functions are the goal of artificial intelligence operations, robotics and the like. Attempts to design machines to perform these functions successfully would benefit from an understanding of how the brain has succeeded in doing so.

Both brain and machine depend on component operations. There is reason to believe that systems supporting complex, goal-seeking adaptive behavior are best constructed out of goal-seeking adaptive components. Limited understanding of how such components work has prevented their incorporation into present artificial intelligence systems.

In the brain the basic component is the neuron. Recent studies indicate that single cortical neurons adapt in such a way as to support adaptive mammalian behavior. Post-synaptically, adaptation is reflected at the cellular level by a change in neural excitability to injected current. We propose to focus our studies on analysis of this type of adaptation. The objective is to determine if cellular mechanisms controlling the adaptation operate in a manner analogous to goal-seeking. The latter might be a function of excitatory or inhibitory ionic conductances, cyclic nucleotide gradients, or other measurable variables that could persistently influence the level of neural excitability.

The approach is to study control of changes in cellular excitability directly in single cortical neurons. The specific methodology is described within the proposal. If successful, this research should lead to an improved understanding of neuronal adaptive mechanisms underlying intelligent information processing by the brain and afford the design of improved components for use in artificial intelligence.

Advances made in our research during the past year include (1) determinaion of effects of cyclic AMP, a neuromodulatory chemical, on neurons of the motor cortex and (2) documentation, by computer analysis, of a 100-fold increase in the rate ot acquisition of conditioned learning by adding stimulation of the hypothalamus to tne usual associative presentatins of CS and US. Further details are described in the Progress Report tnat follows.

PROGRESS REPORT

A. Publications (first grant year)

1. Woody, C.D., Ribak, C.E., Sakai, M., Sakai, H., and Swartz, B. Pressure microinjection for the purposes of cell identification and subsequent ultramicroscopic analysis. In: Current Trends in Morphological Techniques, Vol. II (Ed. J.E. Johnson, Jr.), CRC Press, Inc., 1981.

2. Woody, C.D. Studies of conditioning and other forms of adaptation in the mammalian CNS, In: Vol. 36 Cellular Analogues of Conditioning and Neural Plasticity Ed. Feher, O., and Joo, F., Advances in Physiological Sciences, Pergamon Press and Akademiai Kiado, Oxford, pp. 117-128, 1981.

3. Berthier, N.E., Betts, B. and Woody, C.D. Rapid conditioning of eyeblink reflex: response topography. Soc. Neurosci. Abstr. 7:750, 1981.

B. Summary of Research (first grant year)

1. Effects on cortical neurons of intracellular application of cyclic AMP (cAMP) have been investigated. cAMP was applied by pressure microinjection (0.1 mM solution in 4% HRP injected at 60-80 psi for 1-5 seconds). The following effects were seen in HRP injected cells: a) decreases in firing rate, b) hyperpolarization, c) small decreases in membrane resistance, d) small decreases in excitability to intracellularly injected current. Pyramidal cells of layer V were among those showing these responses. The results indicate that excitability and membrane resistance are decreased by intracellular cyclic AMP. Control studies with intracellular applications of 5' AMP (an inactive, metabolized form of cyclic AMP) did not show these effects. The differences between experimental and control groups were statistically significant.

2. Programming of the PDP 11-44 computer has led to the completion of specific objective 1 of the proposed research.

Computer Program

The program consists of three functional units: stimulus presentation and data collection, histogram generation and display, and behavioral analysis and data storage. Conditioned (CS), unconditioned (US), hypothalamic (HS), and discriminative (DS) stimuli are presented in a timed sequence for ten second trials of adaptation, conditioning, extinction, or delayed HS paradigms. Timing of stimuli can be generated

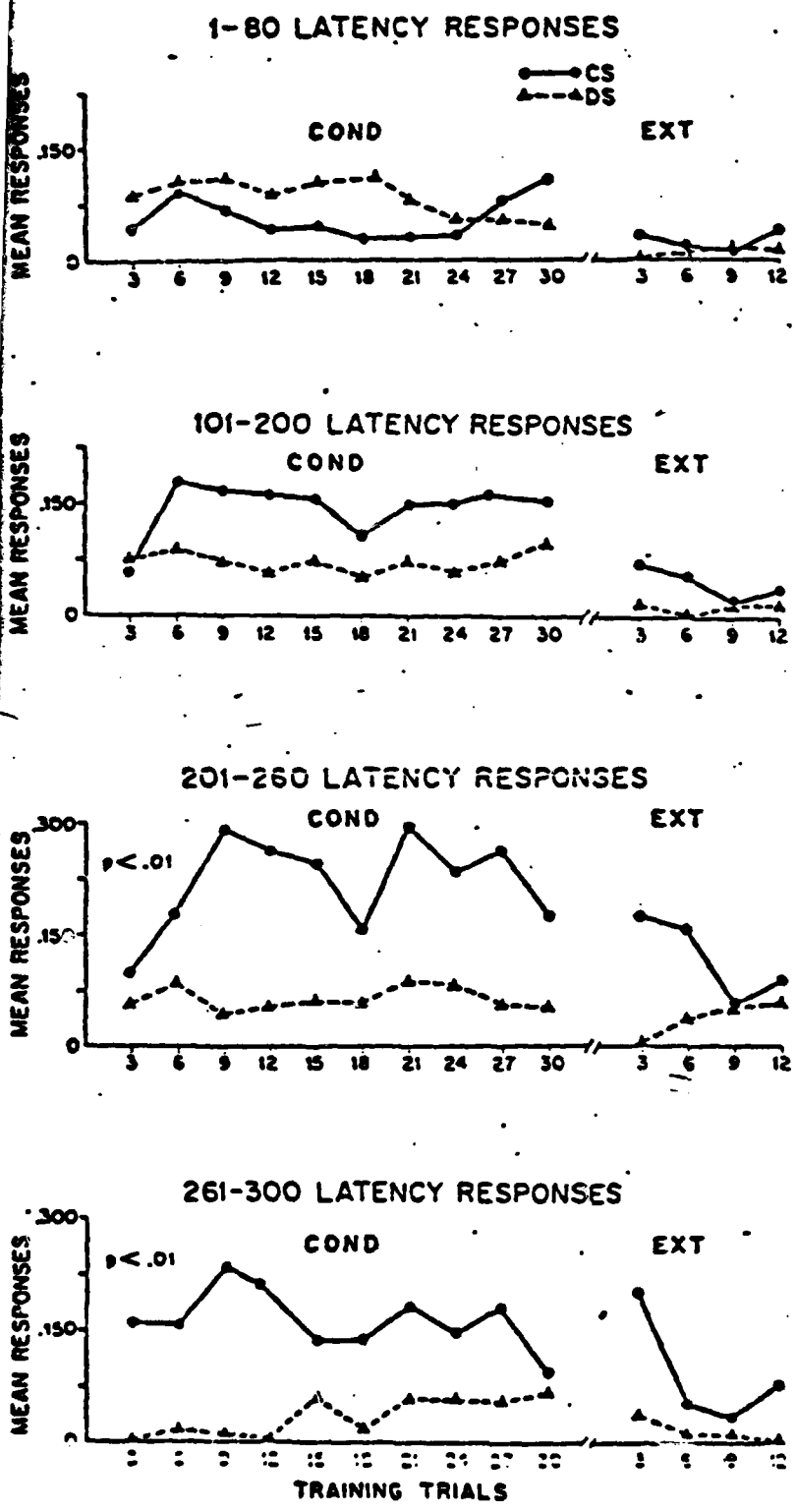
spontaneously for on line experiments or synchronized to an analog tape pulse for analysis of prerecorded data. During each trial, five seconds of EMG data encompassing all stimuli are sampled at 2 ms intervals from the lert and right orbicularis oculi and levator oris. Eight histograms are generated from the data and displayed four each on Mime 100 and VT105 video terminals. The histograms are averages of three trials and are normalized to the tallest bin. The Mime 100 histograms are 400 ms displays encompassing the CS-US period for each EMG. The VT105 histograms can be dynamically modified by keyboard codes which can center histograms around any stimuli for any EMG and display from 100 to 1600 ms of data.

The computer detects conditioned EMG responses using the criteria that 3 consecutive samples in the current trial plus 1 of the 2 previous trials plus the average of those 3 trials must exceed 5 standard deviations above the mean of spontaneous activity sampled for 400 ms before the CS. The response must be detected between 100 ms after the CS and 20 ms before the US. If a response based on these criteria is found, the three trials are individually stored on disc while no response results in three trials being averaged before disc storage.

Results

The results of training cats with click CS, tap US, hypothalamic stimulation (HS), and an added hiss DS are shown on the next page. They indicate tnat, with this paradigm, discriminative responses to the CS are acquired within 9 trials. The rate of acquisition is two orders of magnitude faster then when HS is omitted and permits intracellular recording from cortical neurons while learning takes place. The latencies of the CRs range between 100 and 300 ms. An abstract of these findings has been published (ref. 3, p. 10).

Rapidity of Conditioning and Latency of CR's



Development of EMG responses of different latencies to CS (Solid line) or DS (Dashed line) in 8 cats during conditioning. Responses were defined as EMG responses of greater than 5 sd above the pre-CS (spontaneous) mean. During training, CRs increased with trials reaching asymptote (74% CRs) within 9 trials. Responses were classified into four windows (0-80 ms, 101-200 ms, 201-260 ms, 261-300 ms; top to bottom, respectively). Cats made more responses to the CS than DS when responses of greater than 101 ms were analyzed. During extinction cats made more responses to the CS than to the DS, but by the ninth trial of extinction there was little responding to either the CS or DS.

C. Publications supported by AFOSR (1976 - Present)

1. Woody, C.D. Alterations in neuronal excitability supporting sensorimotor integration. Proc. Intl. Union Physiol. Sci. 12: 604, 1977.

2. Sakai, M., Sakai, H. and Woody, C. Identification of intracellularly recorded neocortical neurons by intracellular pressure microinjection of horseradish peroxidase (HRP) and in vivo biopsy. Fed. Proc. 36: 1294, 1977.

3. Woody, C.D. If cyclic GMP is a neuronal second messenger, what's the message? In: Cholinergic Mechanisms and Psychopharmacology, D.E. Jenden, (Ed.) Plenum, New York, 1977, pp. 253-259.

4. Woody, C.D., Swartz, B.E. and Gruen, E. Persistent, correlated effects of acetylcholine (ACh) and Cyclic GMP (cGMP) on input resistance of neocortical neurons of awake cats. Proc. Intl. Union Physiol. Sci. 13: 820, 1977.

5. Sakai, M., Sakai, H. and Woody, C. Intracellular staining of cortical neurons by pressure microinjection of horseradish peroxidase and recovery by core biopsy. Exp. Neurol. 58: 138-144, 1978. (a)

6. Sakai, M., Sakai, H. and Woody, C.D. Sampling distribution of intracellularly recorded cortical neurons identified by injection of HRP. Fed. Proc. 37: 251, 1978.

7. Woody, C.D. A possible role for cyclic GMP (cGMP) as an intracellular messenger for acetylcholine (ACh) at muscarinic synapses in the mammalian cortex. In: Iontophoresis and Transmitter Mechanisms in the Mammalian Central Nervous System, R.W. Ryall and J.S. Kelly, Eds. Elsevier/North Holland, Inc., New York, 1978.

8. Sakai, M., Swartz, B.E. and Woody, C.D. Measurements of volume ejected in vitro through fine tipped glass microelectrodes by the pressure microinjection technique. Western Nerve Net Abst., 1978.(c)

9. Sakai, M., Sakai, H. and Woody, C. Sampling distribution of morphologically identified neurons of the coronal-pericruciate cortex of awake cats following intracellular injection of HRP. Brain Res. 152: 329-333, 1978.

10. Woody, C.D. and Gruen, E. Characterization of electrophysiological properties of intracellularly recorded neurons in the neocortex of awake cats: a comparison of the response to injected current in spike

overshoot neurons. Brain Res. 158: 343-357, 1978.

11. Sakai, M., Swartz, B.E. and Woody, C.D. Controlled microrelease of pharmacologic agents: measurements of volume ejected in vitro through fine tipped glass microelectrodes by pressure. Neuropharmacol. 18: 209-213, 1979.

12. Woody, C.D., Swartz, B.E. and Gruen, E. Effects of acetylcholine and cyclic GMP on input resistance of cortical neurons in awake cats. Brain Res. 158: 373-395, 1978.

13. Swartz, B.E., Woody, C.D. and Jenden, D.J. The effects of aceclidine, a muscarinic agonist on neurons in the sensorimotor cortex of awake cats. Proc. West. Pharm. Soc. 21: 11-17, 1978.

14. Levine, D.S. and Woody, D.C. Effects of active versus passive dendritic membranes on the transfer properties of a simulated neuron. Biol. Cybernetics 31: 63-70, 1978.

15. Tzebelikos, E. and Woody, C.D. Intracellularly studied excitability changes in coronal-pericruciate neurons following low frequency stimulation of the cortobulbar tract. Brain Res. Bull. 4: 635-641, 1979.

16. Swartz, B.E. and Woody, C.D. Correlated effects of acetylcholine and cyclic guanosine monophosphate on membrane properties of mammalian neurocortical neurons. J. Neurobiol. 10: 465-488, 1979.

17. Woody, C.D., Sakai, H., Swartz, B., Sakai, M., and Gruen, E. Responses of morphologically identified mammalian, neocortical neurons to acetylcholine (ACh), aceclidine (ACec) and cyclic GMP (cGMP). Soc. Neurosci. Abstr. 5: 601, 1979.

18. Kim, H-J. and Woody, C.D. Facilitation of eye-blink conditioning by hypothalmic stimulation. Soc. Neurosci. Abstr. 5: 319, 1979.

19. Brons, J. and Woody, C.D. Changes in responsiveness to glabella tap among neurons in the sensorimotor cortex of awake cats. Soc. Neurosci. Abstr. 5: 314, 1979.

20. Sakai, H. and Woody, C.D. Identification of auditory responsive cells in the coronal-pericruciate cortex of awake cats. J. Neurophysiol. 44: 223-231, 1980.

21. Nahvi, M.J., Woody, C.D., Tzebelikos, E., and Ribak, C.E. Electrophysiological characterization of morphologically identified neurons in the cerebellar cortex of awake cats. Exp. Neurol. 67: 368-376, 1980.

22. Ribak, C.E., Woody, C.D., Nahvi, M.J., and Tzebelikos, E. Ultrastructural identification of physiologically recorded neurons in the cat cerebellum. Exp. Neurol. 67: 377-390, 1980.

23. Brons, J.F. and Woody, C.D. Long-term changes in excitability of cortical neurons after Pavlovian conditioning and extinction. J. Neurophysiol. 44: 605-615, 1980.

24. Woody, C.D. and Gruen, E. Effects of cyclic nucleotides on morphologically identified cortical neurons of cats. Proc. Int. Union Physiol. Sci. 14: 789, 1980.

25. Woody, C.D., Ribak, C.E., Sakai, M., Sakai, H., and Swartz, B. Pressure microinjection for the purposes of cell identification and subsequent ultramicroscopic analysis. In: Current Trends in Morphological Techniques, Vol. II (Ed. J.E. Johnson, Jr.), CRC Press, Inc., 1981.

26. Woody, C.D. Studies of conditioning and other forms of adaptation in the mammalian CNS, Vol. 36 Cellular Analogues of Conditioning and Neural Plasticity Ed. Feher, O., and Joo, F. Advances in Physiological Sciences, Pergamon Press and Akademiai Kiado, Oxford, pp. 117 - 128, 1981.

27. Berthier, N.E., Betts, B., and Woody, C.D. Rapid conditioning of eyeblink reflex: response topography. Soc. Neurosci. Abstr. 7:750, 1981.

LIST OF PROFESSIONAL PERSONNEL ASSOCIATED WITH THE RESEARCH EFFORT

Charles D. Woody

L. Bindman, Ph.D.

N. Allon, Ph.D.

J-r. Liu

H-z. Shao

N. Berthier, Ph.D.

CURRICULUM VITAE

Name: Charles Dillon Woody

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Education:

1957 - A.B. Princeton University
1962 - M.D. Harvard Medical School (Magna Cum Laude)

Positions Held:

1977 - Professor, Anatomy, Psychiatry and Biobehavioral Science, UCLA (in Residence)

1976 - 1977 Associate Professor in Residence of Anatomy and Psychiatry, University of California at Los Angeles

1971 - 1976 Associate Professor in Residence of Anatomy, Physiology, and Psychiatry, University of California at Los Angeles

1968 - 1971 Research Officer (permanent), Laboratory of Neural Control, NINDS, NIH, Bethesda, Maryland

1967 - 1968 Harvard Moseley Fellow with Dr. Jan Bures, Institute of Physiology, Czechoslovakian Academy of Sciences. Prague, Czechoslovakia

1964 - 1967 Research Associate, Laboratory of Neurophysiology, NIMH, NIH, Bethesda, Maryland

1963 - 1964 Research Fellow in Neurology, Harvard Medical School, Resident in Neurology, Boston City Hospital, Boston

1962 - 1963 Intern in Medicine, Strong Memorial Hospital, University of Rochester, Rochester, New York

1960 - 1961 NIH Post-sophomore Research Fellow at Stanley Cobb Laboratory, Massachusetts General Hospital, Harvard Medical School, Boston

1959 (summer) Research Assistant, Communications Biophysics Group, Massachusetts Institute of Technology, Cambridge, Massachusetts

Honors and Fellowships:

Leon Resnick Prize for promise in research, Harvard Medical School, 1962
Moseley Fellowship (Harvard Medical School), 1967-1968
Nightingale Prize (Biol. Engng. Soc. and Internat. Fed. Med. Biol. Engng. for best paper - International Journal: Med. Biol. Engng. 1966-1968) 1969
Honorary Member, Pavlovian Institute, U.S.S.R., 1972
Representative of Society for Neuroscience to Physiological Reviews
Member, Brain Research Institute, and Mental Retardation Research Center, UCLA
Member, Neuroscience Committee supervising the UCLA Medical Center Graduate Program in Neuroscience
Bing Fellowship (Natl. Acad. Sci.) - Visiting scientist to USSR and Czechoslovakia, 1972
Chairman, Session on "Brain and Behavior", FASEB Annual Meeting, 1973
Chairman, Session on "Behavior and Conditioning", International Congress of Physiological Science, New Delhi, 1974
Invited Research Scientist and Lecturer at Kyoto University Primate Center, Japan; sponsored by Japan Society for the Promotion of Science, 1975
Chairman, Session on "Behavior and Neuroethology", FASEB Annual Meeting, 1977
Invited Panelist, Session on "Association Systems and Sensorimotor Integration", International Physiological Congress, Paris, 1977
Chairman, Session on "Neurotransmitters", Soc. for Neuroscience, October, 1979.
Exchange Fellowship (National Academy of Science), Prague, 1979.
Consultant to Publications Committee, American Physiologic Society, 1980.
Grant Proposal Reviewer, NSF, NIH, ADAMHA, NIMH
Consultant Biopsychology Study Section, NIMH, 1981

Editorial Service and Research Consulting:

Member, Editorial Board, Physiological Reviews 1974-1980
Editor, Soviet Research Reports, UCLA Brain Information Service
Member, Editorial Board, Brain Research Bulletin
Member, Editorial Board, Neuroscience and Behav. Physiol.
Member, Board of Editorial Commentators, Current Commentary in Behavioral and Brain Sciences
Reviewer for: EEG. Clin. Neurophysiol., Physiol. Behav., J. Comp. Physiol. Psychol., Behav. Biol., J. Neurophysiol., Exper. Neurol., Brain Res., Exp. Brain Res., Science, Grant Proposals for National Science Foundation and NIH.
Site Visitor at Irvine Medical Center for Extramural Research Branch NIAAA.
Reviewer, National Institute of Mental Health, Basic Psychopharmacology and Neuropsychology Research Review

CURRICULUM VITAE

Name: Nahum Allon

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[redacted]

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1963-1966: Military Service as an officer

1967-1970: B.Sc. in Biology, Tel Aviv University

1970-1973: "Studies on venom synthesis, secretion and injection in viperid snakes" M. Sc. thesis under the supervision of Prof. E. Kochva, in the Dept. of Zoology, Tel Aviv University

1974-1979: "Neural activity in the medial geniculate body of squirrel monkey (Saimiri sciureus) in response to auditory stimuli" Ph.D. thesis under the supervision of Dr. Z. Wollberg in the Dept. of Zoology, Tel Aviv University

1979 Assistant Research psychophysiology
Neuropsychiatric Institute, UCLA
Supervisor: C.D.Woody, MD

Recent Research:

1. Changes in excitability of units in cat pericruciate cortex to weak extracellular stimulation during conditioning
2. The ionic mechanism underlying the excitation of cells in the motor cortex by weak extracellular currents

PUBLICATIONS

Allon, N. and Kochva, E. (1972) Amount of venom injected into mice and rats by Vipera palaestina in a single bite. Am. Zool. 12:685.

Kochva, E., Oron, U., Bdolah, A. and Allon, N. (1972) Regulacao da secrecao e injecao de venamo em serpentes viperideos. Simposio: "Aplicacao de venenos das serpentes em Problemas de Farmacologia e Bioquimica cellular". Ribeirao Preto S.P. Brazil.

Allon, N. and Kochva, E. (1974) The quantities of venom injected into pray of different sizes by Vipera palaestina in a single bite. J. Exp. Zool., 188:71-76.

Kochva, E., Oron, U., Bdolah, A. and Allon, N. (1975) Regulation of venom secretion and injection in viperid snakes. Toxikon 13:104.

Allon, N. and Wollberg, Z. (1978a) Superior colliculus of squirrel monkey: Responses of single cells to auditoty stimuli: Abstract presented in the Israel Society of Physiology and Pharmacology.

Allon, N. and Wollberg, Z. (1978b) Response properties of cells in the superior colliculus of the squirrel monkey to auditory stimuli. Brain Res. 159:321-330.

Allon, N. and Wollberg, Z. (1978c) Responses of cells in the medial geniculate body (MGB) of squirrel monkey to auditory stimuli. Neuroscience letters suppl. 1:52

Allon, N. and Wollberg, Z. (1980) The response properties of cells in the medial geniculate body (MGB) of awake squirrel monkey to species specific vocalization. Soc. Neurosci. Abstr., Vol. 6, p.333.

Allon, N. Yeshurun, Y. and Wollberg, Z. (1981) Responses of single cells in the medial geniculate body of awake squirrel monkey. Exp. Brain Res. 41: 222-232.

Yeshurun, Y., Allon, N., and Wollberg, Z. (1981) A computer aided simulation of an electrode penetration into deep brain structures. Computers and Biomed. Res. 14: 19-31.

Brons, J. F., Woody, C. D., and Allon, N. (1981) Changes in the excitability to weak intensity extracellular electrical stimulation of units of the pericruciate cortex in cats. Submitted for publication to: J. Neurophysiol.

Signature _____ Date 4.11.81

Curriculum Vita

Neil E. Berthier

July, 1980

PII Redacted [redacted]

II. Educational Background:

A. Attended University of Massachusetts, Amherst Ma. from September 1975 to present. M.S. May 1978, Ph.D. expected January 1981. Concentration in Neurobiology of Learning and Memory, Advisor J.W. Moore.

B. Attended Virginia Polytechnic Institute and State University, Blacksburg Va. from September 1971 to March 1975. B.S. June 1975 with Distinction in Psychology.

C. Graduate Courses Taken:

	Instructor:
Statistical Inference in Psychology	A. Pollatsek
Physiological Psychology	R. Feldman, R. Gold G. Wade, J.W. Moore
Neuroanatomical Basis of Behavior	R. Feldman
Advanced Applied Statistics	J. Myers
Conditioning	J.W. Moore, J. Ayre
Comparative Neurophysiology	G. Wyse
Psychopharmacology	R. Feldman
Animal Learning	J. Ayres
Human Information Processing	A. Pollatsek
Neurobiology of Learning and Memory	J.W. Moore
Developmental Neurobiology	D. Noden
Experimental Neurophysiology	G. Wyse

Courses Audited:

Calculus I, II, and Multivariate Calculus	
Minicomputers	D.N. Spinelli
Neurochemistry	J. Meyer

III. Professional Positions:

A. Teaching Assistant and Associate September 1975 to May 1980, Assisted and prepared exams and lectures for courses in Physiological Psychology, Animal Learning, Statistics, Methods, and Introductory Psychology.

IV. Professional Specialties:

Neurobiology of Learning and Memory, Animal Learning.

V. References:

Dr. J. W. Moore, Department of Psychology
University of Massachusetts, Amherst, Ma. 01003

Dr. G. A. Wyse, Department of Zoology
University of Massachusetts, Amherst, Ma.

Dr. K. V. Fite, Department of Psychology
University of Massachusetts, Amherst, Ma.

Dr. E. Dzendolet, Department of Psychology
University of Massachusetts, Amherst, Ma.

VI. Publications and Presentations:

Berthier, N.E., Spinelli, D.N., Solomon, P.R. & Moore, J.W. Fiber-sparing lesions of the central nervous system produced by cyanide. Presented by Moore at the European Brain and Behavior Society's workshop on the Cerebral Commissures, Rotterdam, March, 1977.

Moore, J.W., Yeo, C. & Berthier, N.E. Brain mechanisms of Pavlovian Inhibition. Presented at the Annual meeting of the Psychonomic Society, San Antonio, 1978.

Powell, G.M., Berthier, N.E. & Moore, J.W. Efferent neuronal control of the nictitating membrane in rabbit (Oryctolagus cuniculus): A reexamination. Physiology & Behavior, 1979, 23, 299-308.

Berthier, N.E. & Moore, J.W. Role of the extraocular muscle in rabbit (Oryctolagus cuniculus) nictitating membrane response. Physiology & Behavior, 1980, 24, 931-937.

Berthier, N.E. & Moore, J.W. Spatial differential conditioning of the nictitating membrane response in hippocampectomized rabbits. Physiological Psychology, 1980, in press.

Berthier, N.E. & Moore, J.W. Disrupted conditioned inhibition of the rabbit nictitating membrane response following mesencephalic lesions. Physiology and Behavior, 1980, submitted.

Berthier, N.E. & Moore J.W. Multiple unit activity of the abducens nerve in the anesthetized and paralyzed rabbit. To be presented at the Society for Neuroscience annual meeting, 1980.

RESUME

1. Name: Liu Jin-rong

2. Sex: male

[redacted] PII Redacted

[redacted]

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6. Present Occupation: Lecturer

7. Office Address: Department of Biology, Peking University, Peking

8. University Education: 1955-1960 study in Physiology Section of Department of Biology, Peking University

9. Professional and teaching experience:

1960-1979 work in Physiology Section of Dept. of Biology Peking University

Teaching:

1960-1962
1977-1978 Physiology & experiment of Physiology for 2nd year student

1963-1964 Anatomy of C.N.S. & Neurophysiology for 3rd year student

1965 General Neurophysiology for 3rd year student

1962-1965
1972-1976 Set lab. of Electrophysiology & instruct 3rd year student in experiment of Electrophysiology

1973-1974 Instruct 4th year student to do research work
Subject: "the influence of acupuncture of "Jen-Chung" & "Ho-Ku" points on the cerebral evoked potential of rabbit. (unpublished)

10. Publications or prepared for publication:

1. Xu Wei, Tan Yuling, Liu Jinrong et al.
The role of cerebral cortex in acupuncture analgesia.

2. Xu Wei, Tan Yuling, Liu Jinrong et al.
Preliminary observation on the effect of acupuncture on cortical evoked potentials in patients receiving brain operation.

3. Xu Wei, Tan Yuling, Liu Jinrong et al.
The influence of lesion of unilateral cerebral somatosensory area on the cortical evoked potentials and effect of acupuncture in human body.

[redacted]

4. Xu Wei, Tan Yuling, Liu Jinrong et al.
   A preliminary observation on the influence of Fentanyl & Ketamine of cortical potentials evoked by painful stimulation in Man.
   Proceedings of Symposium of International Congress of Acupuncture Analgesia, Peking, China. p. 324, p. 326, 1979.

5. Mc Lennan, H. and Liu Jinrong.
   The post-excitatory effects of acidic amino acids on spinal neurones.
   (J. of Canadian Physiol. & Pharmacol. 1981 in press)

6. Liu, Jinrong and Mc Lennan, H.
   A comparison of the actions of certain antagonists of excitatory amino acids.
   (as communication of a Scientific Meeting of the Physiological Society held in London, Dec. 1980)

CURRICULUM VITAE

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Name: Dr. Lynn J. Bindman [redacted]

Address: Department of Physiology,
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Education: South Hampstead High School for Girls, London

University College London, Department of Physiology
1957-1963

Degrees: BSc London 1960 Class Upper II
PhD London 1964 Physiology of the cerebral cortex

Posts held:

1963-1965	Honorary Research Assistant, Department of Physiology, UCL, Grant awarded by Medical Research Council
1965-1969	Assistant Lecturer (part-time) Department of Physiology, UCL
1969-1972	Research Associate (part-time) Department of Physiology, UCL. Grant awarded by Medical Research Council
1972-	Lecturer, Department of Physiology, UCL

Membership of Societies

The Physiological Society	- elected 1967
The Pharmacological Society	- elected 1976
International Brain Research Organisation	- elected 1978
Brain Research Association	

Research:

LIPPOLD, O.C.J., REDFEARN, J.W.T. & WINTON, L.J. (1961). The potential level at the surface of the cerebral cortex of the rat and its relation to the cortical activity evoked by sensory stimulation. J. Physiol., 157, 7-9P

BINDMAN, L.J., LIPPOLD, O.C.J. & REDFEARN, J.W.T. (1961). The diffusion of γ-amino butyric acid within the mammalian cerebral cortex and the non-selective nature of its blocking action. J. Physiol., 160, 24-25P

BINDMAN, L.J., LIPPOLD, O.C.J & REDFEARN, J.W.T. (1962). The prolonged after-action of polarizing currents on the sensory cerebral cortex. J. Physiol., 162, 45-46P

BINDMAN, L.J., LIPPOLD, O.C.J. & REDFEARN, J.W.T. (1962). Long-lasting changes in the level of the electrical activity of the cerebral cortex produced by polarizing currents. Nature, 196, 584-585

BINDMAN, L.J., LIPPOLD, O.C.J. & REDFEARN, J.W.T. (1962). Variations in evoked potentials and potential gradients in the sensory cortex. Proc. XXII Int. Congr. Physiol. Sci., Leiden, Sept. 10-17

BINDMAN, L.J., LIPPOLD, O.C.J. & REDFEARN, J.W.T. (1962). The non-selective blocking of γ-amino butyric acid on the sensory cerebral cortex of the rat. J. Physiol., 162, 105-120

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Connected with Teaching:

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Audiotapes with booklets:

1) BINDMAN, L.J. (1978) Interpretation of experimental data in Physiology, based on a study of Calcium Metabolism. Board of Studies in Physiology, University of London. Distributed by the BLAT Centre for Health & Medical Education, BMA House, London.

2) SMAJE, L.H. & BINDMAN, L.J.(1975) Methods of Contraception. Board of studies in Physiology, University of London. Distributed by BLAT, BMA House, London.

3) BINDMAN, L.J. & DAVIES, M. (1979) The Autonomic Nervous System I Anatomy and Physiology, Audiotapes and booklets. Board of Studies in Physiology, University of London. Distributed by the BLAT Centre for Health and Medical Education, BMA House, London.

Demonstration

At Physiological Society (in addition to scientific demonstrations listed among publications)

BINDMAN, L.J., JEWELL, B.R. & SMAJE, L.H. (1975) J. Physiol. 249, 19P Display of self-instruction material for teaching Physiology.

Film

"Lung Surfactant" by L.J. BINDMAN & L.H. SMAJE, for use at UCL demonstrated at Phys. Society. 1975.

Name: Shao Zuo Hua

Sex: Female

PII Redacted [redacted]

Present Occupation: Research Associate.

Office Address: The Institute of Biophysics, Chinese Academy of Science, Beijing, China.

University Education:

1955--1960 Study in the Physiology Section of Department of Biology, Peking University.

1960--1965 graduate student, at the Physiology Section of Department of Biology, Peking University

Professional Experience:

1966--1981 Research work in the Institute of Biophysics, Chinese Academy of Science.

Major in using electron microscopy, scanning electron microscopy, histology to study the ultrastructure of nervous system and sense organs of some animals.

Publications:

1. Shao Zuo-hua, Yin Chung-yang, Zheng Guo-zhong:
Studies on the ultrastructures of Herbst Corpuscles in the legs of pigeons.
Acta Zoologica Sinica vol.25(3) p191-195 1979

2. Liang Chang-lin, Shao Zuo-hua.
Studies on the ultrastructures of taste bud in the barbel of the Catfish (Parasilurus Asotus)
Acta Zoologica Sinica vol.27(3) 1981

3.Pilleri,G; Chen,Pei-xun; Shao,Zuo-hua.

Concise Microscopical Atlas of the Brain of the Common Dolphin (Delphinus Delphis Linnaeus, 1758)

Brain Anatomy Institute, Univ. of Berne

Waldau-Berne (Switzerland) 1980

4.Chen.Pei-xun; Shao, Zuo-hua; Pilleri,G.

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5.Chen,Pei-xun; Shao, Zuo-hua; Pilleri,G.

Regression of the Optic system in the Changjiang(Yangtze) Finless Porpois (Neophoceana asiaeorientalis)

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6.Chen,Pei-xun; Shao, Zuo-hua; Pilleri,G.

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7.Shao Zuo-hua.

Studies of high nervous activity of hibernant animal-hedgehog.

Communication of Peking University 1965.

8.Shao Zuo-hua.

Studies on the ultrastructure of recepter of taste buds of some fish (in press)

9.Shao Zuo-hua.

Studies on the ultrastructure of Brain, Skin, Melon of Neophoceana asiaeorientalis (in press)

UCLA STANDARD PROCEDURE 1210.1 - ATTACHMENT A

University of California, Los Angeles
Campus Veterinarian, IV-211 C.H.S.
Telephone: (213) 825 6240

Office Use Only
Application #_____ Project ID #_____
Effective_____ Expiration_____

APPLICATION FOR USE OF LABORATORY ANIMAL SUBJECTS

1. Applicant Charles D. Woody, MD Department NDT/MD
Phone: Office 825-0187 Home

2. Contact for animal problems & emergencies Charles D. Woody, MD
Phone: Office 825-0187 Home

3. Title of research or training project/activity Neurophysiological Research Supporting the Investigation of Adaptive Network Architectures

4. Starting Date 6/1/80 to 5/31/84 ☐ New ☒ Continuation ☐ Renewal ☐ Supplemental

5. ☒ Extramural funding, Acad. Senate, or Cal. Inst. for Cancer Res.: *Attach copy of proposal application.*

6. ☐ Intramural or other funding: *On cont. page outline project's objectives, animal purchasing & care budget.*

7. Animal Use Sites – building(s)/room(s) 58-147, 58-159, 57-384.

8. For animals held in laboratory more than 12 hours, does housing conform to DHEW Guide: ☒ Yes ☐ No

9. Species/Strain/Breed Cat Sex ___ Age/Weight Range _____

10. Total number for entire project/activity 20-40 per annum Expected Daily Population 12

11. ☐ Special procurement or processing needs: *Specify on continuation page.*

12. ☐ Procurement of dead animal material: *Answer questions 1-12 only and sign application.*

13. ☐ Short term use (up to 2 weeks) ☐ Long term use (more than 2 weeks) ☒ Both ☐ Breeding program

14. ☒ *Standard housing, diet, sanitation & pest control* ☐ Special needs: *Specify on continuation page.*

15. ☐ Project involves no pain or distress to animal subjects. *Refer to "Guiding Principles" #5.*

16. ☒ Project involves probable pain or distress to animal subjects. *Details of procedures on animals*
presented in: ☐ *proposal application* ☐ *continuation page* ☒ *attached journal reprint*

17. ☒ Pain or distress relieved by anesthetic, analgesics, tranquilizers. *Use cont. page for add'l drugs.*
Cite: Drug(s) NA Pentobarbital Dosage 30mgm/kg Route IP

18. ☐ Pain or distress cannot be relieved. *Explain basis for exception on continuation page.*

19. ☐ Surgery: ☐ Nonsurvival ☒ Survival ☒ Aseptic Surgery ☐ Multiple surgeries on same animal

20. Procedure for sick/dead animals: ☐ Veterinary attention ☐ Discard ☒ Notify applicant

21. ☒ Euthanasia: Cite: drug(s) Nembutal Route IP
Cite other method(s) _____

22. ☐ Special veterinary & technical services required: *Specify on continuation page.*

23. ☐ Potential biological or radiation hazard to: ☐ Humans ☐ Animals *Describe on continuation page.*

USE CONTINUATION PAGE(S) FOR ADDITIONAL INFORMATION

UCLA STANDARD PROCEDURE 1110.1 - ATTACHMENT A

University of California, Los Angeles
Campus Veterinarian, M-211 C.H.S.
Telephone: (213) 825-6240

Office Use Only

Application # _____ Project ID # _____
Effective _____ Expiration _____

APPLICATION FOR USE OF LABORATORY ANIMAL SUBJECTS

A separate application must be completed and typewritten for each proposed project or activity utilizing animals.* Applications should be directed to the Campus Veterinarian for review, but can be sent after funding agency deadlines. However, an approved application is required for the University to accept extramural funds and before any animals can be ordered.

Applicant Charles D. Woody, MD

Phone: Office 825-0187 Home _____

Department/Division NPI/MR

Title of Research or Training Project/Activity Neurophysiological Research Supporting the Investigation of Adaptive Network Architectures

Estimated Starting Date 6/1/80 Estimated Completion Date 5/31/84

The undersigned attests to the attached information, and agrees to accept responsibility that all animal use in the above-titled project or activity will be in accordance with University, Federal, and other relevant policies and regulations. Any changes will be communicated to the Chancellor's Committee/Campus Veterinarian.

Signature Charles D. Woody 5/23/80

Charles D. Woody, MD (Title) Professor of Anatomy and Psychiatry (Date)

*"Animal" *means any live or dead vertebrate.*

For Committee Use Only

☐ Application Approved: Effective Date _____ Expiration Date _____ ☐ Application Disapproved

Comments:

Signature _____

(Title) (Date)